Toward a plankton-based predictor of tuna recruitment

Phoebe Woodworth-Jefcoats

NOAA Fisheries – Pacific Islands Fisheries Science Center

Johanna Wren

NOAA Fisheries – Pacific Islands Fisheries Science Center

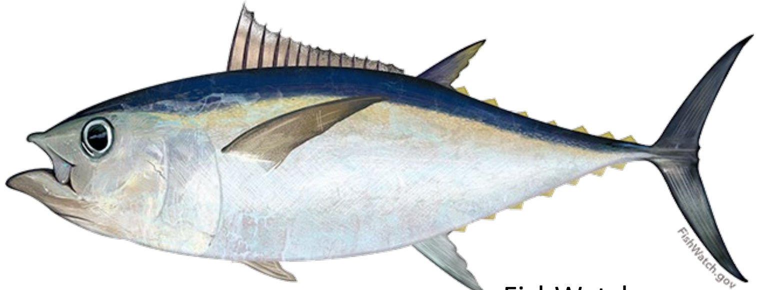
Woodworth-Jefcoats PA and Wren JLK, 2020. Toward an environmental predictor of tuna recruitment. *Fisheries Oceanography*, 29(5): 436–441. https://doi.org/10.1111/fog.12487

Bigeye Tuna *(Thunnus obesus)* is an important resource that is potentially strained

In recent years, in Hawaii's deep-set longline fishery, bigeye tuna have comprised approximately:

- 35% of all fish caught
- 40% of fish retained
- 55% of catch in weight
- 60% of ex vessel revenue

Intermittently experiencing overfishing, assessments include noted uncertainty

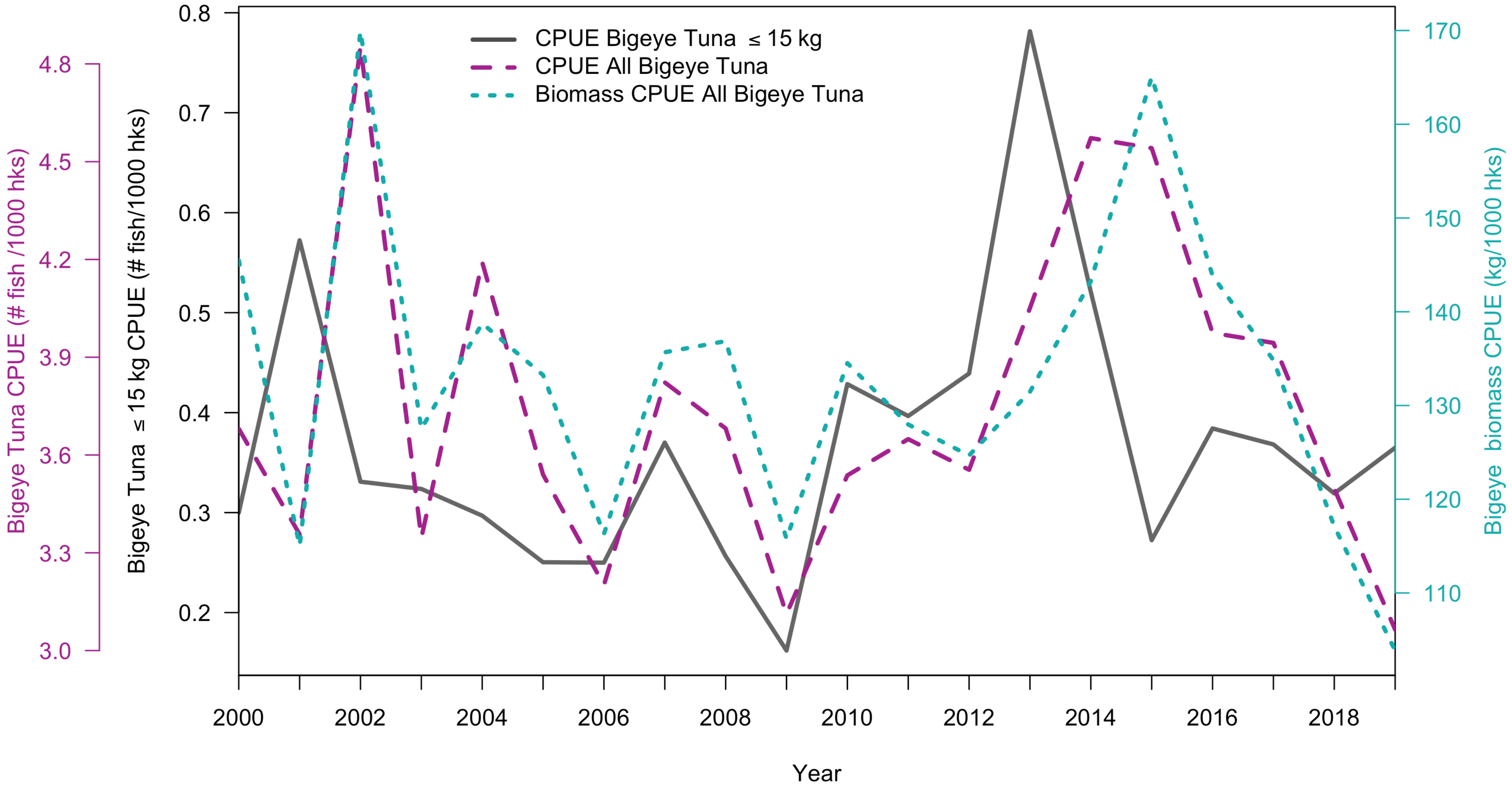


FishWatch.gov

Abascal et al. 2018; Aires-da-Silva and Maunder 2015; Ducharme-Barth et al. 2020; Harley et al. 2014; McKechnie et al 2017; Xu et al. 2018

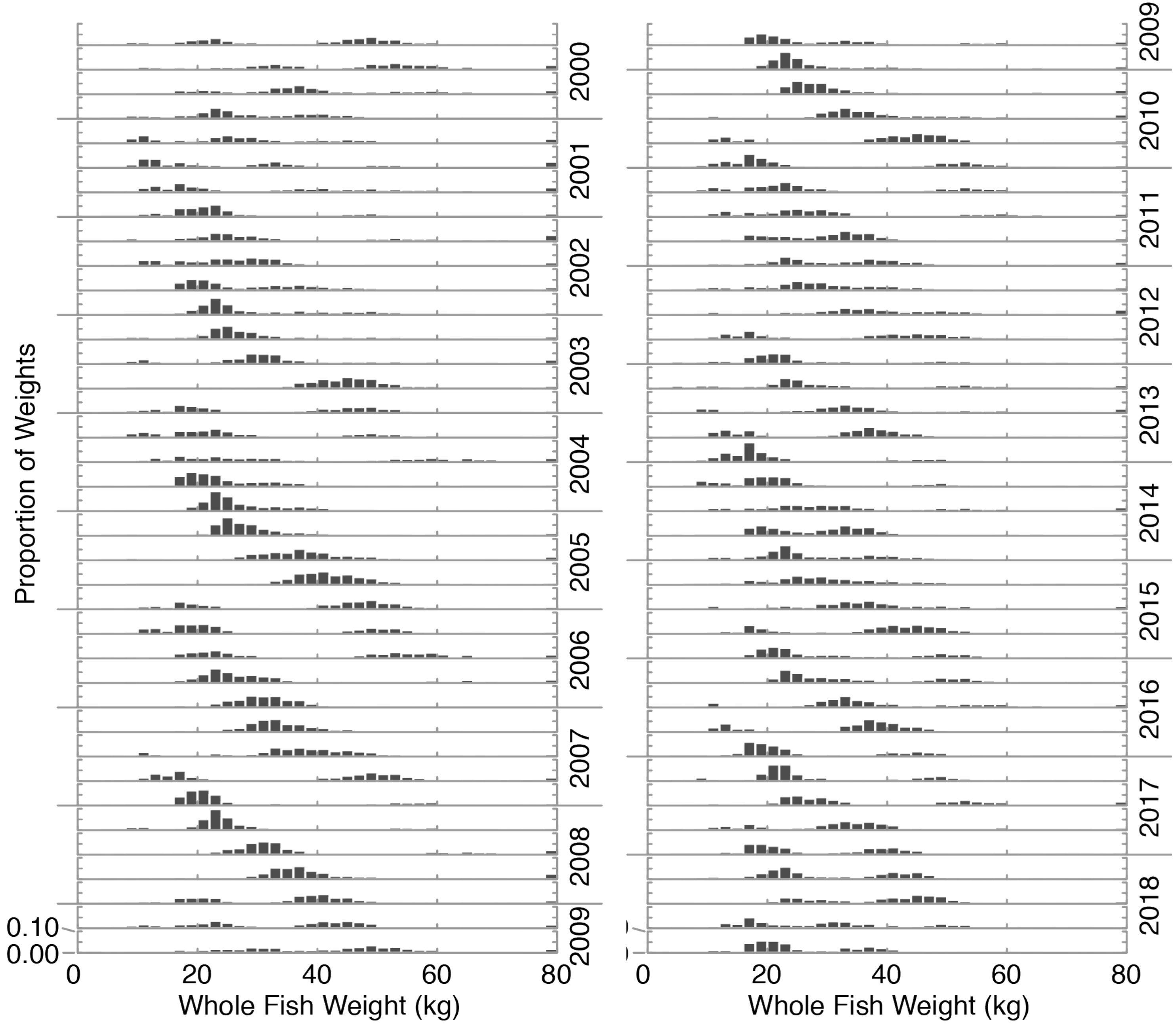
WPRFMC 2020: Annual SAFE Report Pacific Island Pelagic FEP 2019

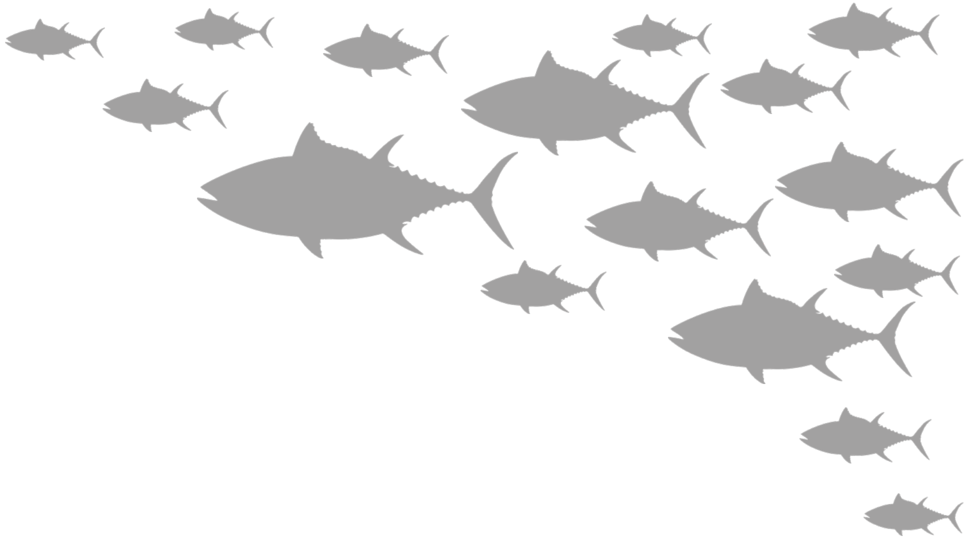
Recruitment Index



Wren and Polovina, In Review

WPRFMC 2020: Annual SAFE Report Pacific Island Pelagic FEP 2019

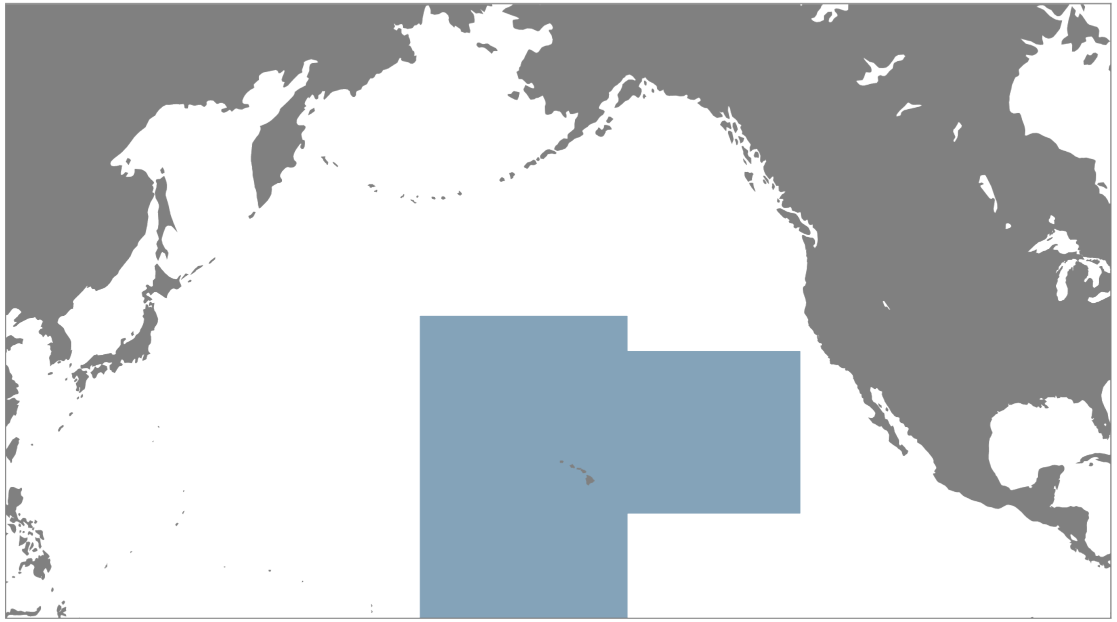




Coherent stock structure

Estimating plankton size from satellite data

Sea surface temperature, *SST*
Surface chlorophyll concentration, *chl-a*



Median phytoplankton mass, M_{B50}:

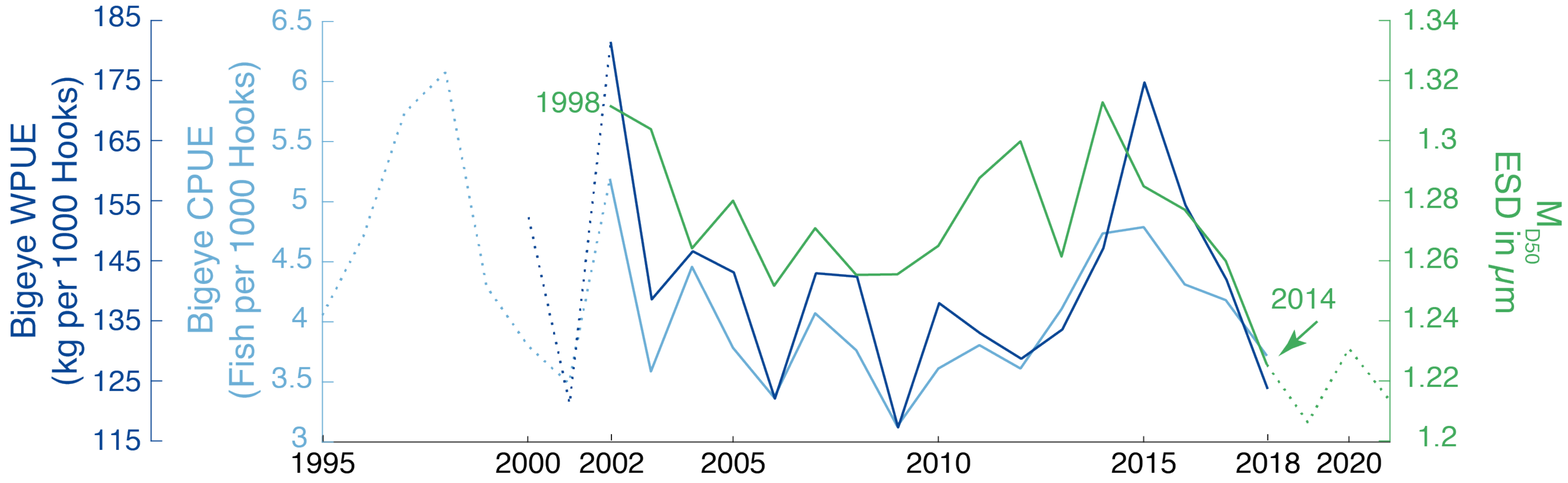
$$\log_{10}(M_{B50}) = 0.929 \log_{10}(chl{-}a) - 0.043\,(SST) + 1.340$$

Median phytoplankton size, M_{D50}:

$$M_{D50} = 2.138\,(M_{B50})^{0.355}$$

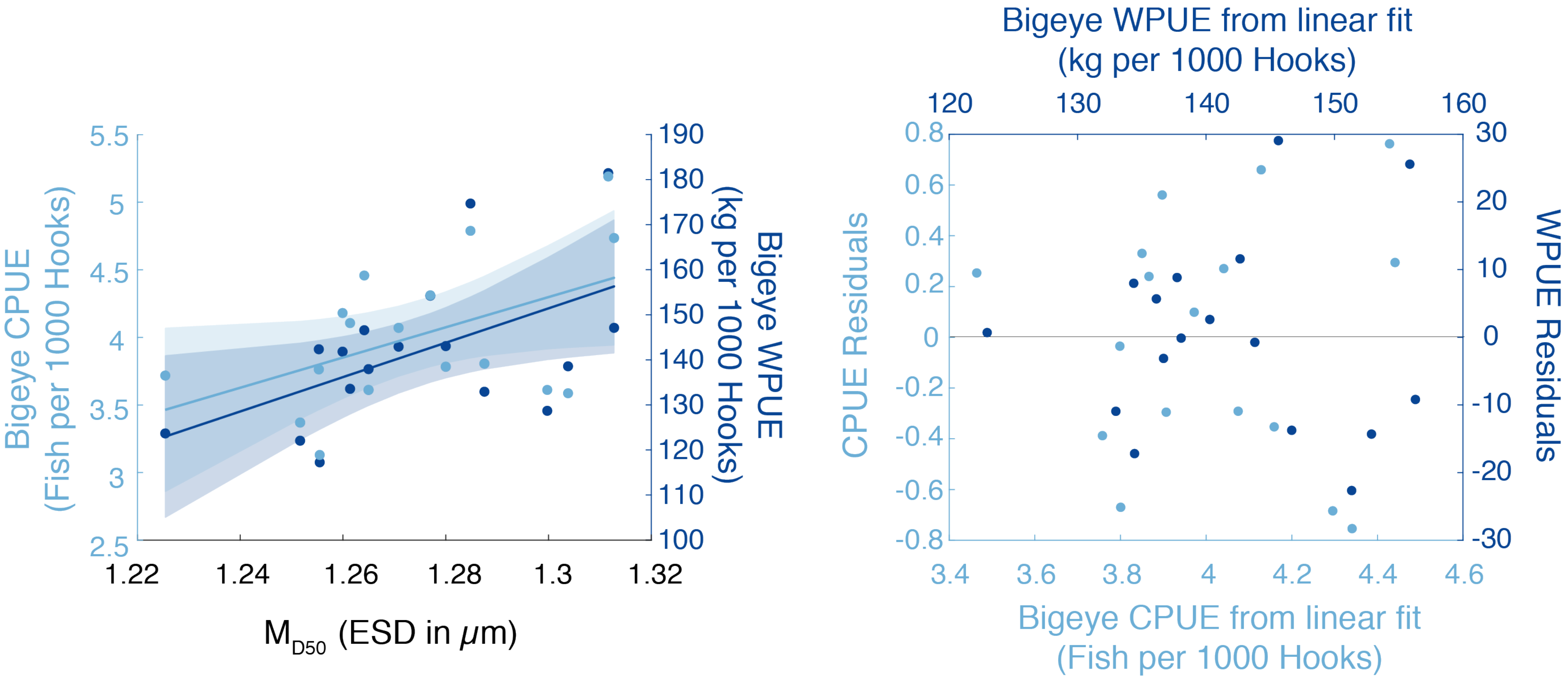
Barnes et al. 2011; Menden-Deuer and Lessard 2000; Polovina and Woodworth 2012

Comparison between CPUE, WPUE, and 4-year-lagged M_{D50}



***r* = 0.54** ***r* = 0.48**

Comparison between CPUE, WPUE, and 4-year-lagged M_{D50}



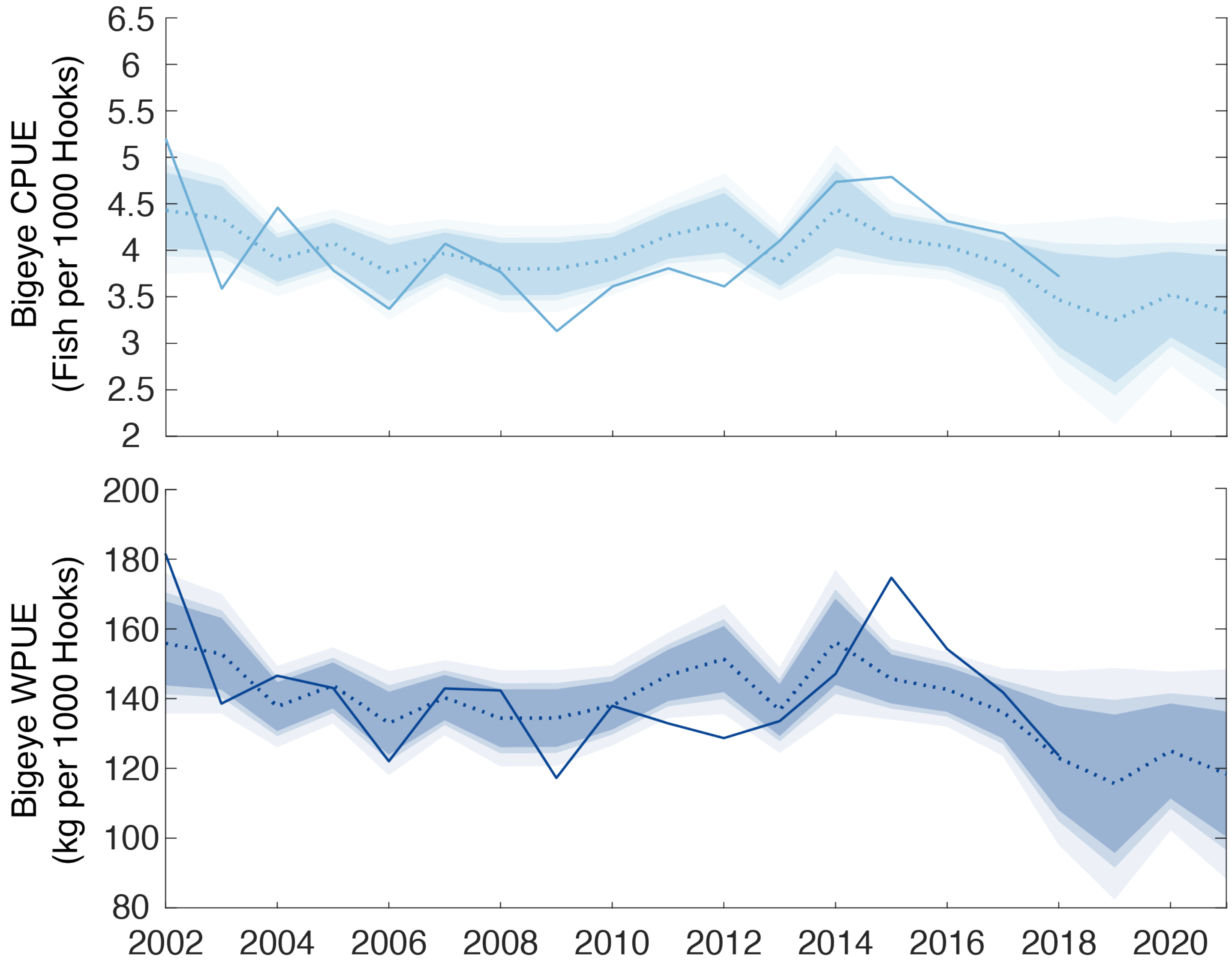
Forecast skill: $\sum|forecast - observation|$

<u>CPUE skill (fish per 1,000 hooks)</u>

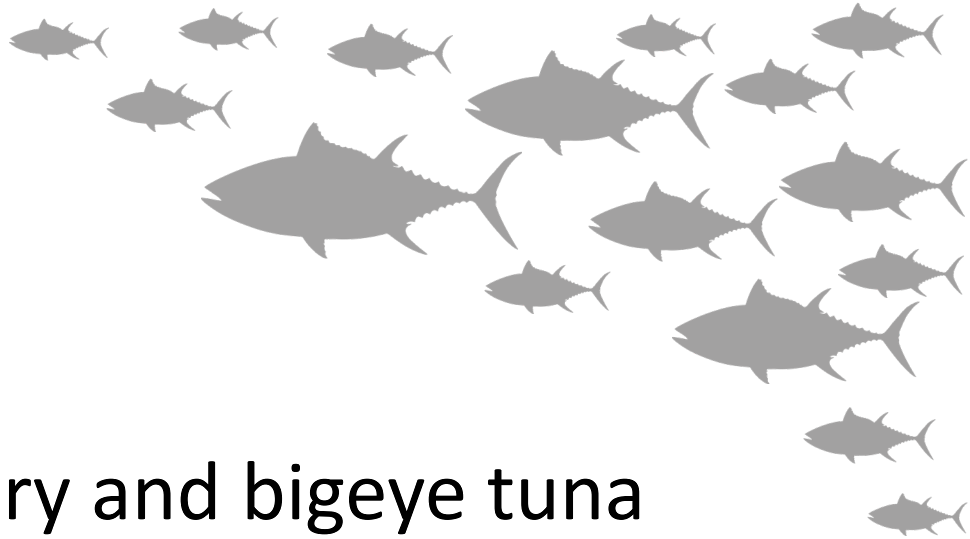
Plankton-based:	6.9
Climatology:	9.2
Persistence:	10.0

<u>WPUE skill (kg per 1,000 hooks)</u>

Plankton-based:	184
Climatology:	220
Persistence:	309



Next steps



Specific to Hawaii’s deep-set longline fishery and bigeye tuna

- Advanced statistical approaches to include environmental data
- Spatiotemporal analysis
- Additional estimates of juvenile mortality, e.g., purse seine catch

Further uses

- Potential for use with other species and regions

Conclusions

- Satellite-derived estimates of phytoplankton size can be used to skillfully forecast bigeye tuna catch rates up to four years into the future
- The forecast is based on ecological theory, is fisheries independent, and easily derived from publicly available data
- Working to incorporate the underlying ecological relationship in additional fishery applications

Johanna.Wren@noaa.gov • Phoebe.Woodworth-Jefcoats@noaa.gov